US Army Corps of Engineers.
Construction Engineering Research Laboratory

Fact Sheet

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REMOTE CORROSION MONITORING TECHNOLOGY

The Problem

Underground structures such as pipes and underground storage tanks usually must be unearthed for inspections to determine their corrosion status and check for damage. These "dig-ups" are expensive and give little insight into mechanisms of the corrosion process. In addition, coated submerged structures, such as lock gates, bulkheads, and pilings used to support piers and bridges, need to be evaluated periodically to determine if recoating is necessary.

The Technology

The U.S. Army Construction Engineering Research Laboratory (CERL) is developing a remote corrosion monitoring system using electrochemical impedance techniques [alternating current (AC)] and electrochemical polarization decay [direct current (DC)] for monitoring corrosion in underground pipes, piles, and steel encased in concrete.

Small amplitude AC excitations are applied to the structure being evaluated over a range of frequencies, and the response is measured. The impedance response indicates the reaction rates of the corrosion process and provides a detailed description of the structure's corrosion condition. This method can be used to estimate the amount of underfilm corrosion which is taking place on the structure as well as the amount of bare steel area which has been exposed through coating damage or deterioration.

For the DC technique, the corrosion potential of the structure being tested is shifted by approximately 150 millivolts. The voltage source is then removed, and the potential is allowed to decay. The rate of decay is analyzed by an equivalent "RC" circuit and can be correlated to the percent bare area of the structure.

Benefits/Savings

Using these methods would prevent the need for costly "dig-ups" presently required to determine the corrosion status of underground gas pipes, while providing valuable data describing the mechanical process of corrosion. The techniques are also applicable to submerged coated structures such as piles as well as steel encased in concrete and will help ensure that they are properly maintained.

Status

Remote corrosion monitoring using AC impedance techniques is presently under development for pipes, piles, and steel encased in concrete.

A patent was obtained for the DC polarization decay technique in September 1986 (U.S. Patent 4,611,175). Long-term studies of the DC technique were completed on steel H-pilings at Buzzard's Bay, MA, and La Costa Island, FL, during FY95. The results of the electrochemical measurements generally correlated well with visual observations and flange thickness measurements conducted on the pilings. Baseline data for the evaluation of coating status on sector gates at Franklin Lock, FL, were collected during FY93. DC polarization decay and resistance data were obtained. Periodic data collection is

planned at Franklin Lock to correlate the deterioration over the coating's life with electrochemical measurements.

The long term performance can be successfully predicted by short term testing by measuring the degradation rate accurately using electrochemical resistance and then predicting the performance based on the degradation exponent.

The results of the 20 year corrosion monitoring study of coated steel pilings at Cape Cod, MA, have been published. Recent publications include:

A. Kumar and J.H. Boy, "Analysis of Polarization Decay of Reinforced Concrete in Saltwater," published in the Proceedings of The National Association of Corrosion Engineers, Corrosion 96, Paper No. 331, Houston, TX, March 1996;

A. Kumar, V.L. Van Blaricum, A. Beitelman, and J. Boy, "Twenty Year Field Study of the Performance of Coatings in Seawater," published in Corrosion Testing in Natural Waters, Ed. by R.M. Kain, ASTM Special Technical Publication, American Society for Testing and Materials, Philadelphia, Nov. 1995;

A. Kumar, V. Van Blaricum, and J.H. Boy "Modeling of Coating Degradation and Polarization Decay of Coated Steel in Salt Water," published in the Proceedings of the Electrochemical Society 188th Annual Meeting, Symposium on Environmentally Acceptable Inhibitors and Coatings, Chicago IL, Oct. 1995.

Points of Contact

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